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# Randomised Field Trial for the Performance Diagnostics and Risk Reduction of Rural Water Treatment Systems in Rwanda

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## ABSTRACT

**Background:** Rural water treatment systems in sub-Saharan Africa are critical for public health, yet their operational performance and associated public health risks are often poorly quantified. Existing assessments are typically cross-sectional, limiting causal inference about the efficacy of diagnostic and intervention strategies.

**Purpose and objectives:** This case study aimed to develop and apply a randomised field trial methodology to rigorously diagnose performance failures and measure the risk reduction achieved through a standardised maintenance intervention for rural water treatment facilities.

**Keywords:** *Randomised controlled trial, Sub-Saharan Africa, Water treatment systems, Performance diagnostics, Risk reduction, Rural infrastructure, Public health engineering*

### Article Highlights

- Structured diagnostics and maintenance reduced major failures by 47 percentage points.
- Mean log-reduction value improved by 1.8 units in the intervention arm.
- Methodology provides causal evidence for engineering interventions in rural infrastructure.
- Trial involved 120 community water systems in a clustered randomised design.

### Methodological Note

The study employed a generalised linear mixed model to analyse clustered trial data, quantifying uncertainty with robust standard errors.

*This trial establishes a causal framework for evaluating rural water infrastructure interventions.*

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